

CLAIMS

1. Transparent substrate (6), especially made of glass, comprising, on at least one of its faces, an antireflection coating, especially having an antireflection effect at oblique incidence, made of a stack (A) of thin layers of dielectric material having alternately high and low refractive indices, **characterized in that** the stack comprises, in succession:
- a high-index first layer (1), having a refractive index  $n_1$  of between 1.8 and 2.2 and a geometrical thickness  $e_1$  of between 5 and 50 nm;
  - a low-index second layer (2), having a refractive index  $n_2$  of between 1.35 and 1.65 and a geometrical thickness  $e_2$  of between 5 and 50 nm;
  - a high-index third layer (3), having a refractive index  $n_3$  of between 1.8 and 2.2 and a geometrical thickness  $e_3$  of between 70 and 120 nm;
  - a low-index fourth layer (4), having a refractive index  $n_4$  of between 1.35 and 1.65 and a geometrical thickness  $e_4$  of at least 80 nm.
2. Substrate (6) according to Claim 1, **characterized in that**  $n_1$  and/or  $n_3$  are between 1.85 and 2.15, especially between 1.90 and 2.10.
3. Substrate (6) according to either of the preceding claims, **characterized in that**  $n_2$  and/or  $n_4$  are between 1.35 and 1.55.
4. Substrate (6) according to one of the preceding claims, **characterized in that**  $e_1$  is between 5 and 50 nm, especially between 10 and 30 nm or between 15 and 25 nm.
5. Substrate (6) according to one of the preceding claims, **characterized in that**  $e_2$  is between 5 and 50 nm, especially between 10 and 35 nm and preferably less than or equal to 30 nm.
6. Substrate (6) according to one of the preceding claims, **characterized in that**  $e_3$  is less than or equal to 120 nm and especially at least 75 nm.

7. Substrate (6) according to one of the preceding claims, **characterized in that**  $e_4$  is greater than or equal to 80 nm and especially less than or equal to 120 nm.

5 8. Substrate (6) according to one of the preceding claims, **characterized in that** the high-index first layer (1) and the low-index second layer (2) are replaced with a single layer (5) having an intermediate index  $e_5$  of between 1.65 and 1.80 and preferably having  
10 an optical thickness  $e_{opt5}$  of between 50 and 140 nm, preferably between 85 and 120 nm.

9. Substrate (6) according to Claim 8, **characterized in that** the intermediate-index layer (5) is based on a mixture, on the one hand, of silicon  
15 oxide and, on the other hand, at least one metal oxide chosen from tin oxide, zinc oxide and titanium oxide, or is based on a silicon oxynitride or oxycarbide and/or on aluminium oxynitride.

10. Substrate (6) according to one of the preceding  
20 claims, **characterized in that** the high-index first layer (1) and/or the high-index third layer (3) are based on one or more metal oxides chosen from zinc oxide, tin oxide and zirconium oxide or based on one or more nitrides chosen from silicon nitride and aluminium  
25 nitride.

11. Substrate (6) according to one of the preceding claims, **characterized in that** the high-index first layer (1) and/or the high-index third layer (3) consist  
30 of a superposition of several high-index layers, especially a superposition of two layers such as  $\text{SnO}_2/\text{Si}_3\text{N}_4$  or  $\text{Si}_3\text{N}_4/\text{SnO}_2$ .

12. Substrate (6) according to one of the preceding claims, **characterized in that** the low-index second layer (2) and/or the low-index fourth layer (4) are  
35 based on silicon oxide, silicon oxynitride and/or oxycarbide or on a mixed silicon aluminium oxide.

13. Substrate (6) according to one of the preceding claims, **characterized in that** the said substrate is made of clear or bulk-tinted glass.

14. Substrate according to one of the preceding claims, **characterized in that** its light reflection on the side where the stack (A) of thin layers is provided is reduced by a minimum value of 3 or 4% at an angle of incidence of between 50° and 70°.

15. Substrate according to one of the preceding claims, **characterized in that** the colorimetric response of its light reflection on the side where the stack (A) of thin layers is provided is such that the corresponding  $a^*$  and  $b^*$  values in the ( $L^*$ ,  $a^*$ ,  $b^*$ ) colorimetry system are negative at an angle of incidence of between  $50^\circ$  and  $70^\circ$ .

16. Substrate according to one of the preceding claims, **characterized in that** the antireflection stack (A) uses, at least for its high-index third layer, silicon nitride or aluminium nitride so that it is able to undergo a heat treatment of the bending, toughening or annealing type.

17. Glazing according to one of the preceding  
20 claims, **characterized in that** it is composed of the  
single substrate (6) provided, on one of its faces,  
with the multilayer antireflection stack (A) and, on  
its other face, either with no antireflection stack or  
also with a multilayer antireflection stack (A), or  
25 with another type (B) of antireflection coating, or  
with a coating having another functionality of the  
solar-protection, low-emissivity, antifouling,  
antifogging, anti-rain or heating type.

18. Glazing according to one of Claims 1 to 16,  
30 **characterized in that** it has a laminated structure in  
which two glass substrates (6, 6') are joined together  
using a sheet (7) of thermoplastic, the substrate (6)  
being provided, on the opposite side to the join, with  
the antireflection stack (A) and the substrate (6')  
35 being provided, on the opposite side to the join,  
either with no antireflection coating, or also with an  
antireflection stack (A), or with another type (B) of  
antireflection coating, or with a coating having  
another functionality of the solar-protection,

low-emissivity, antifouling, antifogging, anti-rain or heating type, the said coating having another functionality possibly also being on one of the faces of the substrates which are turned towards the thermoplastic joining sheet.

19. Glazing according to one of Claims 1 to 16, **characterized in that** it has a laminated structure with one or more sheets of joining polymer, with the antireflection coating (A) on the 1 and/or 4 faces and, in contact with the joining sheet or one of the joining sheets, a solar-protection coating, especially one consisting of two silver layers.

20. Glazing according to Claim 17 or Claim 18, **characterized in that** the other type (B) of antireflection coating is chosen from the following coatings:

- ⇒ a single low-index layer, having an index of less than 1.60 or 1.50, especially about 1.35-1.48, especially based on silicon oxide;
- ⇒ a single layer whose refractive index varies through its thickness, especially of the silicon oxynitride  $\text{SiO}_x\text{N}_y$  type, where x and y vary through its thickness;
- ⇒ a two-layer stack, comprising, in succession, a layer having a high index of at least 1.8, especially made of tin oxide, zinc oxide, zirconium oxide, titanium oxide, silicon nitride or aluminium nitride, and then a layer having a low index, of less than 1.65, especially made of silicon oxide, oxynitride or oxycarbide;
- ⇒ A three-layer stack comprising, in succession, a layer having a medium index of between 1.65 and 1.8 of the silicon oxycarbide or oxynitride and/or aluminium oxycarbide or oxynitride type, a layer having a high index of greater than 1.9 of the  $\text{SnO}_2$  or  $\text{TiO}_2$  type, and a layer having a low index of less than 1.65, of the mixed Si-Al oxide or silicon oxide type.

21. Process for obtaining the glazing according to one of Claims 17; 18 or 20, **characterized in that** the

antireflection stack or stacks (A) is/are deposited by sputtering and the optional antireflection coating (B) is deposited by a sol-gel technique, by a pyrolysis technique of the CVD or plasma CVD type, by sputtering or by corona discharge.

22. Application of the glazing according to one of Claims 17 to 20 as interior or exterior glazing for buildings, as a shop display cabinet or counter, which may be curved, as glazing for vehicles, such as the side windows, the rear window, the sunroof and the windscreen, or as glazing for protecting objects of the painting type, or as an antidazzle computer screen, or as glass furniture.